An Intelligent Groupware Environment for Real-Time Distributed Medical Collaboration

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Introduction

Network-based, distributed collaborative tools and environments for medical practice are becoming more practical[1], yet most existing commercial groupware is either proprietary or of limited functionalities for manipulating, presenting, and sharing multimedia information such as medical images, text/graphics documents, and audio. We describe here an integrated real-time groupware system using AI methods for intelligent control based on Java and CORBA standards. The prototype system has been tested for collaborative medical image analysis and distributed radiological reporting.

System Overview

The system is an open cross-platform internet-based real-time client-server environment built on CORBA object communication middleware. It is programmed in Java to support object downloading. The client system is loaded with multi-modal and multi-form interfaces, database access functionalities, and multimedia information processing and manipulation tools. Users have the choice of either shared or private modes, or both.
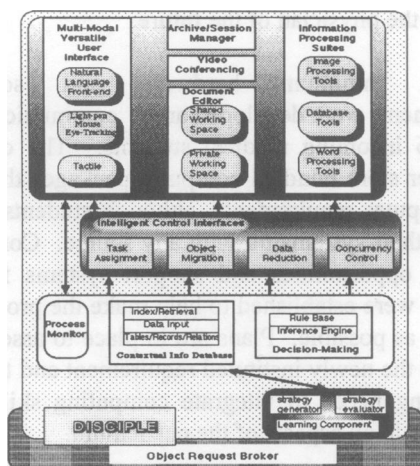

Figure 1 System Overview

The system can be activated locally or through an internet browser over the network. The server has a session manager and task scheduler which coordinates the communication and message passing between the participating clients while scheduling tasks and balancing the load among available computing resources distributed at each client site (Figure 1).

Intelligent Control

An innovative approach has been taken in this system to alleviate potential latencies during collaborative sessions involving multiple users over the network. An intelligent control mechanism reasons with task-specific contextual information, and plans optimal task-assignment and data transmission strategies in a session involving multiple clients so that collaborative group performance can be further improved. Overall group performance of a specific distributed collaborative session depends on the combined effects of network speed, computational power of the servers and clients involved, and the availability and performance of the data analysis tools used. Our approach integrates knowledge-based planning with client-server technology to support dynamic intelligent task-allocation, and speed improvement of multimedia data transmission. We have adapted our rule-based planning system for the composition of image analysis processes [2] and used it as the central decision-making mechanism for our groupware system. The specific operations to be performed by each client system and their sequencing is dynamically determined based on evidence collected in the system's runtime contextual information database (CID) under constraints of synchronization and efficiency. Initial tests with radiological image analysis tasks demonstrate the feasibility of this approach.

References
[1] Heathfield H, Kirby J, Nowlan A, and Rector A.PEN (Geriatrics): a collaborative patient record system for the shared care of the elderly. Proceedings of SCAMC92. 147-150.
[2] Gong L, and Kulikowski CA. Composition of Image Analysis Processes Through Object—Hierarchical Planning. IEEE-PAMI 17:997-1009, 1995.